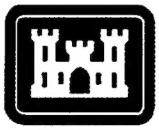
ERDC/CHL TR-01-1



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Development Center

HyPAS User's Manual: A Hydraulic Processes Analysis System

An Extension for ArcView GIS, Version 4.0.1

Thad C. Pratt and Daryl S. Cook

January 2001

Coastal and Hydraulics Laboratory

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HyPAS User's Manual: A Hydraulic Processes Analysis System

An Extension for ArcView GIS, Version 4.0.1

by Thad C. Pratt

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Washington, DC 20314-1000

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Preface

This instruction manual reported herein was written by the Coastal and Hydraulics Laboratory (CHL) of the U.S. Army Engineer Research and Development Center (ERDC) under the sponsorship of the Coastal Inlets Research Program (CIRP).

The work was performed under the general supervision of Dr. J. R. Houston, Director, CHL, Mr. Clark McNair, Program Manager, and Drs. Nicholas C. Kraus, Technical Director, CIRP, W. H. McAnally, Division Chief, CHL, and R. T. McAdory, Branch Chief, CHL. Work was performed by Messrs. Thad C. Pratt, CHL, and Daryl S. Cook of Digital Information and Mapping Company (DIMCO, Inc.).

At the time of publication of this report, Dr. James R. Houston, was Director of ERDC, and COL James S. Weller, EN, was Commander.

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1 Introduction

Modern electronic instrumentation produces large amounts of data. Often, this abundance of data is not utilized because the engineer or scientist does not have an effective way to visualize and analyze all of it within project time schedule. This problem could be minimized by a set of tools that would provide ready capability to visualize, analyze, reduce, and efficiently plot data obtained from such instrumentation. Additionally, such a tool could take advantage of geographically referenced data with high spatial accuracy.

The Hydraulic Processes Analysis System (HyPAS) is designed to be a Geographic Information System (GIS) for hydraulic information. A GIS, a computer system capable of managing, storing, manipulating, and displaying geographically referenced data, is the logical solution to such a problem, in particular, considering the combination of spatial accuracy needs and database management needs. A mapping system alone lacks database management capabilities. A spreadsheet or database management system provides little or no accurate mapping capabilities. GIS software provides both applications with a robust set of tools capable of handling large amounts of data with high spatial accuracy; however, typically a substantial learning investment is required to become proficient with GIS software.

HyPAS builds on the inherent power of GIS while supplying easier tools for facilitation of hydraulic process analysis and reduces the learning curve typical with GIS implementation. It is an extension to ArcView, a commercially available software package marketed by Environmental Systems Research Institute (ESRI), and requires Spatial Analyst, an additional extension from ESRI. HyPAS was designed for the non-GIS expert with ease of use as a priority. A novice user of ArcView can soon become proficient with HyPAS.

HyPAS was developed in support of the U.S. Army Corps of Engineers (USACE) projects. Previous to HyPAS, the delivery of high-resolution survey data could consist of thousands of plots. HyPAS was developed to provide analysis tools along with the data, enabling the USACE field offices further analysis without numerous and costly unnecessary plots. Intensive application in the Coastal Inlets Research Program (CIRP), suggestions from USACE District staff, and experience in a wide variety of applied projects led to the

development of the HyPAS toolbox. These tools have the capabilities for analysis and visualization suited to the particular applications of USACE.

The HyPAS was designed to perform all major functions after data collection to report writing. The system supports hydraulic and hydrodynamic studies involving:

a. Velocity
  (1) Plan view contours
  (2) Plan view vector plots
  (3) Cross-section plots

b. Soil or sediment
  (1) Grain-size distribution plots
    (a) Frequency weight histogram
    (b) Cumulative frequency weight percent
  (2) Composite sample from multiple samples
    (a) Comparing composites with reference curves
    (b) Adjust fill factor (*RA*)
    (c) Renourishment factor (*RJ*)

c. Project management
  (1) Importing photographs
  (2) Time series data analysis

d. New tools are constantly under development to meet sponsors' needs.

HyPAS' velocity analysis tools provide three basic applications: contouring an area in plan view from a user-defined constituent and depth range, generating cross sections from a transect, and plotting vector magnitude and direction in plan view from a user-specified depth range. HyPAS' soil sample analysis tools allow the user to generate frequency weight plots, calculate composite sample plots, and perform varied analysis routines. HyPAS' project management tools allow the user to import photographs for project enhancement and import time series data to manage and plot.

System Specifications

HyPAS Version 4.0.1 is developed to run within ArcView GIS 3.0. All of the ArcView GIS 3.0 minimum requirements must be met. Additionally, the following requirements apply:

a. Intel Pentium or compatible or better.

b. Windows 95, 98, or NT.

c. Additional 5 MB available disk space.

d. ArcView GIS Version 3.0 and 3-D Analyst Extension.

e. 32 MB RAM (64 MB recommended).

f. 1 MB video RAM.

g. Mouse.

HyPAS Additions to ArcView's Graphical User Interface

There are additions to the Graphical User Interface (GUI) that is standard in ArcView. These provide access to HyPAS' applications:

a. Importing ADCP velocity data.

b. Contouring in plan view.

c. Plotting plan view vectors.

d. Generating cross sections.

e. Photo importing.

f. Time series data plotting.

g. Soil sample analysis.

These additions are in the form of GUI buttons (first row of buttons) and tools (second row of buttons). The tools are displayed in Figure 1-1 along with their respective drop-down menus, and the buttons are shown in Figure 1-2.

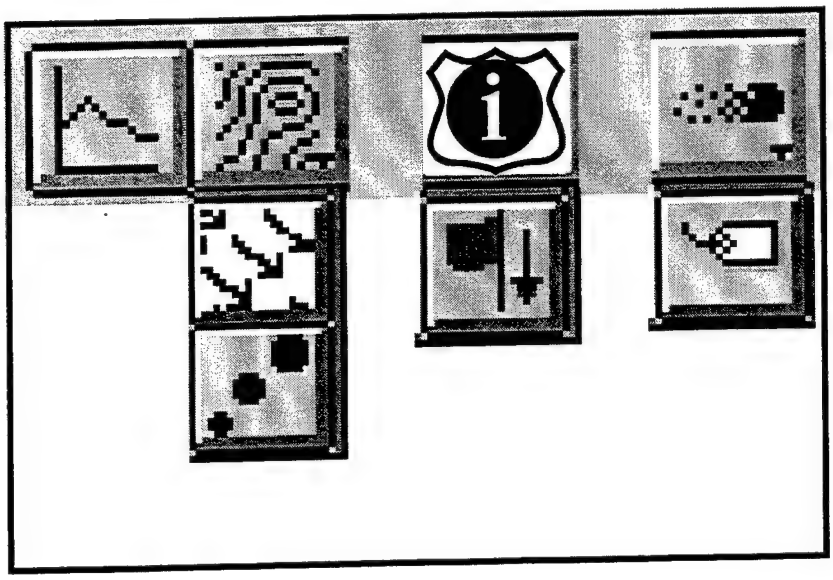

Figure 1.1. Tools added to the standard view GUI in ArcView

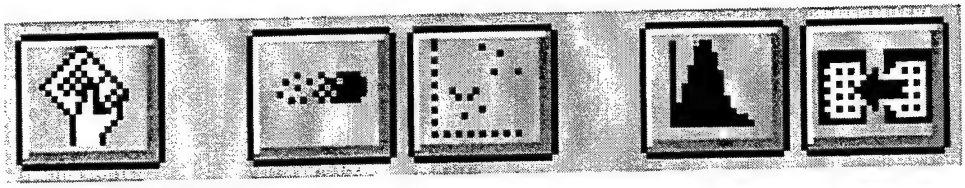

Figure 1-2. Buttons added to the standard view GUI in ArcView

2 Plan View Velocity Analysis

The "Plan View Velocity Analysis" section of this report demonstrates the tools associated with importing and processing Acoustic Doppler Current Profiler (ADCP) data. This instrument captures three-dimensional spatially tagged velocity data through the water column. Typically, lines or transect are collected at the project location. These data then have to be converted from binary to an ASCII format before importation begins. Usually corrections have to be made to the data for magnetic declination or any magnetic anomalies that might be present at the site or due to the collection vessel.

Once the data have passed initial quality control measures, they are ready for importation. After importation there are options for further processing including plan view contours and plan view vectors. Both tools have the ability for further analysis in the form of depth averaging. These options and techniques will be further explained in the following sections.

Importing ADCP Velocity Data

To import ADCP data, click on the *Import Data* for HyPAS button (Figure 2-1) and choose the *Import ADCP Velocity* option (Figure 2-2). Because HyPAS disables plan view analysis options except when the user has a view open containing plan view data, HyPAS makes sure the view has *Plan View* in its name. If the view does not, then HyPAS appends the view name with *Plan View* and notifies the user.

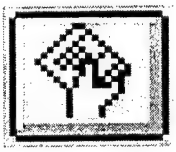

Figure 2-1. Import data for HyPAS button

The user is prompted to select the GIS file(s) (Figure 2-3). After selecting the files, the user is prompted for the data set name (Figure 2-4). This name cannot have more than seven characters, and it will be the theme name in the table of contents at the left of the view. Enter an applicable name.

HyPAS will import the ADCP data set and store it as a point theme and a related database file. Because most applications will include multiple data sets,

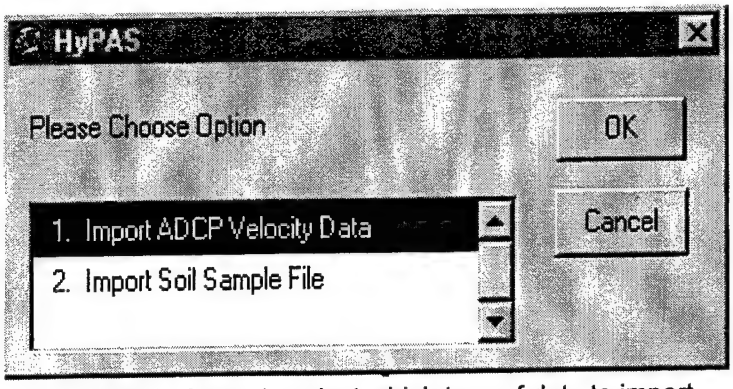

Figure 2-2. Menu to select which type of data to import

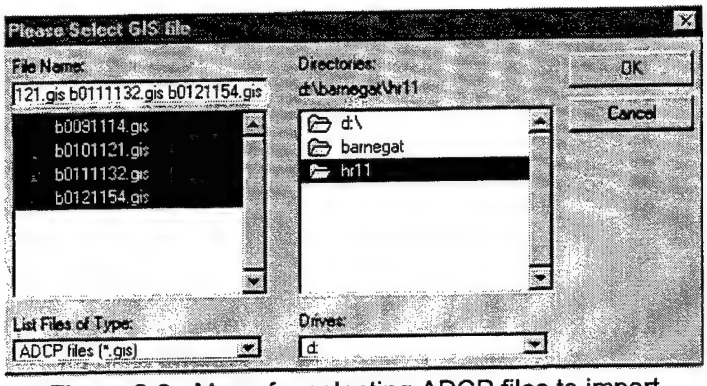

Figure 2-3. Menu for selecting ADCP files to import

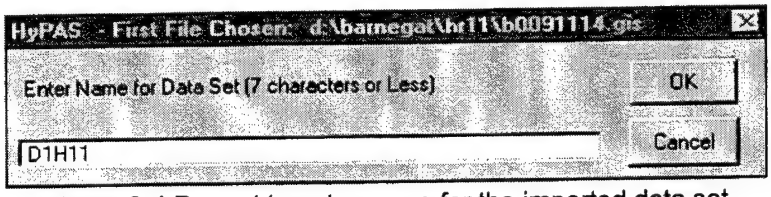

Figure 2-4 Prompt to enter name for the imported data set

HyPAS automatically returns to the prompt to select the GIS file(s). Cancel after the last data set has been imported.

The data file to import must be in the following format:

```
604541.90 338546.80  .0     .00     .000     .0    .0    .0   10.6  61.9 63.6 65.6 56.1 100   .000
604558.90 338580.50  .0   83.32  308.172  -65.5  53.0 -22.6  -41.6  62.7   .0 68.3 50.9 100 -4.733
604558.90 338580.50 1.5   91.49  301.568  -77.9  47.9  -5.9   -6.7  74.9   .0 76.6 69.7 100 -5.240
604558.90 338580.50 2.0   94.23  299.352  -82.1  46.2   -.3    5.0  79.0   .0 79.4 76.0 100 -5.410
604558.90 338580.50 2.5   74.88  308.385  -58.7  46.5    .0    7.4  81.4   .0 80.1 75.4 100 -4.220
604558.90 338580.50 3.0   82.56  307.716  -65.3  50.5    .8   -2.0  82.3   .0 83.1 78.4 100 -4.660
604558.90 338580.50 3.5   75.61  306.515  -60.8  45.0    .6   -6.2  85.8   .0 85.4 80.2 100 -4.280
604579.80 338615.00  .0   68.10  286.254  -76.1  10.9 -19.5  -11.0  65.0   .0 59.8 54.6 100 -4.324
604579.80 338615.00 1.5   99.99  303.013  -83.8  54.5 -10.0   14.0  74.5   .0 73.2 68.0 100 -6.350
```

There must be at least one space between each column of data, and the columns should be in the order as follows:

a. Easting

b. Northing

c. Depth

d. Total Velocity

e. Direction

f. East Component of Velocity

g. North Component of Velocity

h. Vertical Component of Velocity

i. Velocity Error

j. Relative Acoustic Intensity (Echo) Beam 1

k. Relative Acoustic Intensity (Echo) Beam 2

l. Relative Acoustic Intensity (Echo) Beam 3

m. Relative Acoustic Intensity (Echo) Beam 4

n. Percent Good

o. Discharge

Plan View Contours

To contour a plan view, assure that the desired data set is active. First, click the *Plan View Contour* tool. This tool is shown in Figure 2-5. After clicking the tool, the user is prompted to choose a selection method (i.e., box or polygon). This prompt is shown in Figure 2-6. After choosing the selection method, the user is prompted to draw a polygon or box to select the points for analysis.

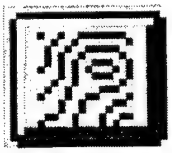

Figure 2-5. Input data for HyPAS button

For box selection, click the mouse on one corner of the area of interest and drag to draw the desired box or rectangle. For polygon selection, click to begin the polygon and continue clicking to design a polygon. After completing the desired polygon, double-click the mouse to close the polygon. The points are selected and HyPAS selects the linked database and zooms to the selected points.

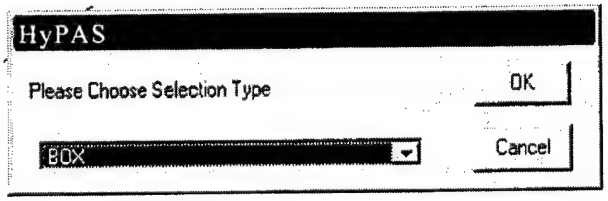

Figure 2-6. Prompt for selection type

After the points are selected, a prompt appears for the *Processing Depth Range* (Figure 2-7). After entering the depth range, click *OK*. HyPAS organizes the data and prompts for the *Output Grid Specifications* (Figure 2-8). The default values will work. A more experienced user may begin to customize these parameters.

The output grid extent parameter defines the external limits of the resulting interpolation. Because HyPAS zooms to the extent of the selected points, the default value *Same as Display* is the best choice. The other three parameters—*Output Grid Cell Size, Number of Rows,* and *Number of Columns*—define the raster intensity of the output grid. These parameters are connected; therefore, changing any one changes all. The user may want to adjust this. Increasing the number of cells smooths the output. The trade-off is it decreases the speed of the interpolation process. The default value will be adequate for most applications, although rounding the cell size will increase clarity.

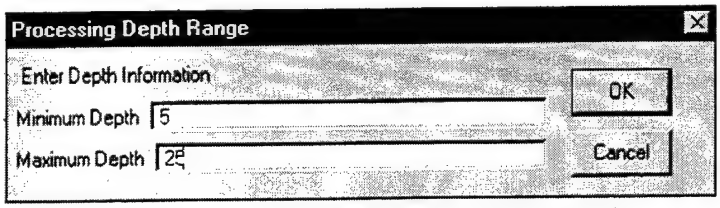

Figure 2-7. Processing depth range prompt

HyPAS then prompts for an *Output Grid* name (Figure 2-9). This is the physical name of the resulting file to be stored on disk. HyPAS then prompts for the constituent to contour (Figure 2-10). Choose the constituent and click *OK*. HyPAS creates a theme with the resulting interpolation. Additionally, the theme will be displayed with a legend.

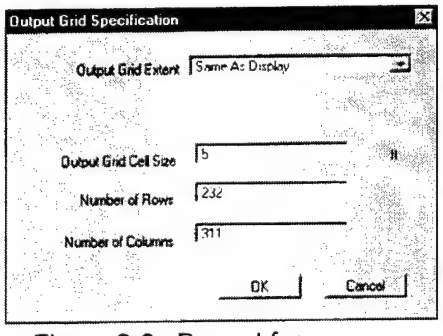

Figure 2-8. Prompt for specifications for the output grid

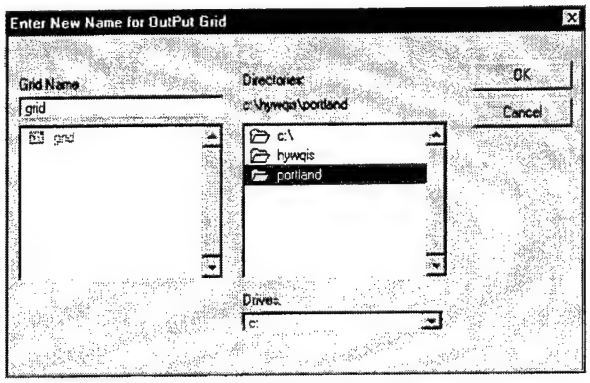

Figure 2-9. Prompt for output grid name

HyPAS then prompts for a contour interval and base contour (Figure 2-11). Enter the desired contour interval and base contour. The user can see the extent of the data by the legend generated with the grid theme. See chapter 7 for plotting.

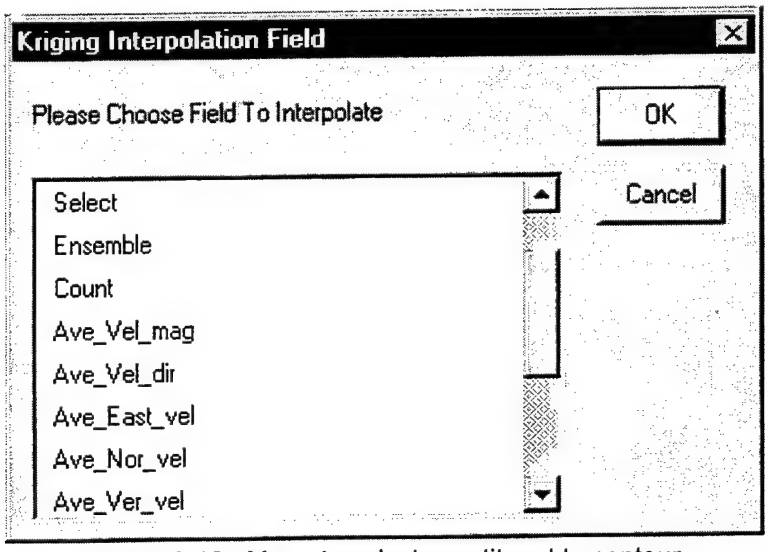

Figure 2-10. Menu to select constituent to contour

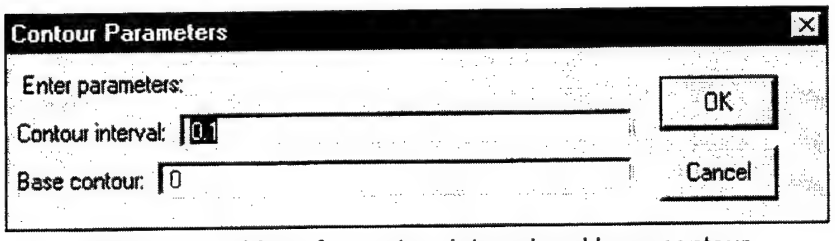

Figure 2-11. Menu for contour interval and base contour

Plan View Vectors

To generate plan view vectors, assure that the desired data set is active. Click the *Plan View Vector* tool to begin (Figure 2-12). HyPAS will prompt to draw a polygon around the desired points to analyze (Figure 2-13). Click defining the vertexes of the polygon and double-click when the polygon is complete.

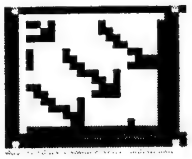

Figure 2-12. Plan view vector tool

HyPAS then prompts for the *Processing Depth Range* (Figure 2-7). HyPAS extracts and organizes the data for use. After extracting and organizing the data, HyPAS prompts for the output file name (Figure 2-14). This is the name for the theme HyPAS will create for the plan view vectors. Enter a name and choose *OK*.

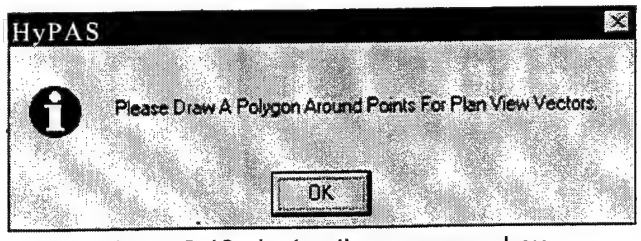

Figure 2-13. Instruction message box

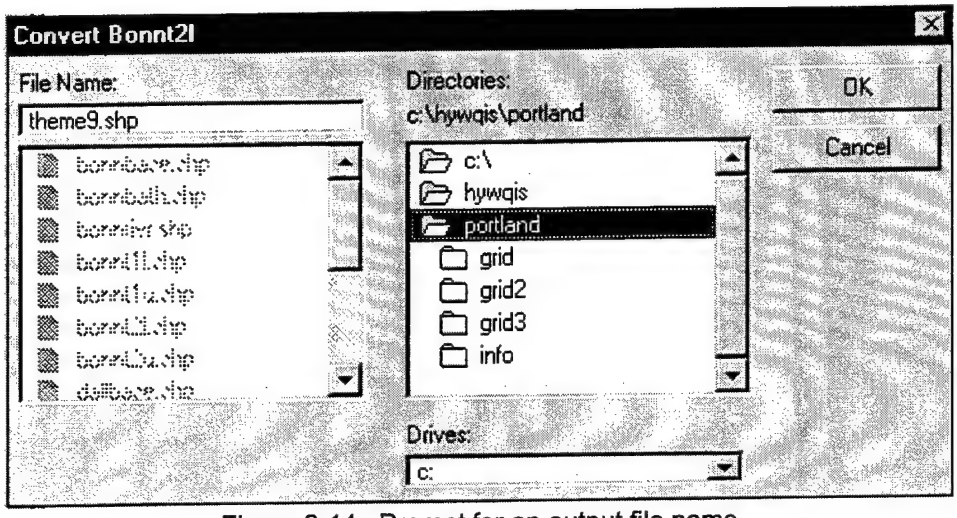

Figure 2-14. Prompt for an output file name

HyPAS creates a theme with vectors. These vectors are scaled using the total velocity magnitude and displayed in the direction of flow (Figure 2-15).

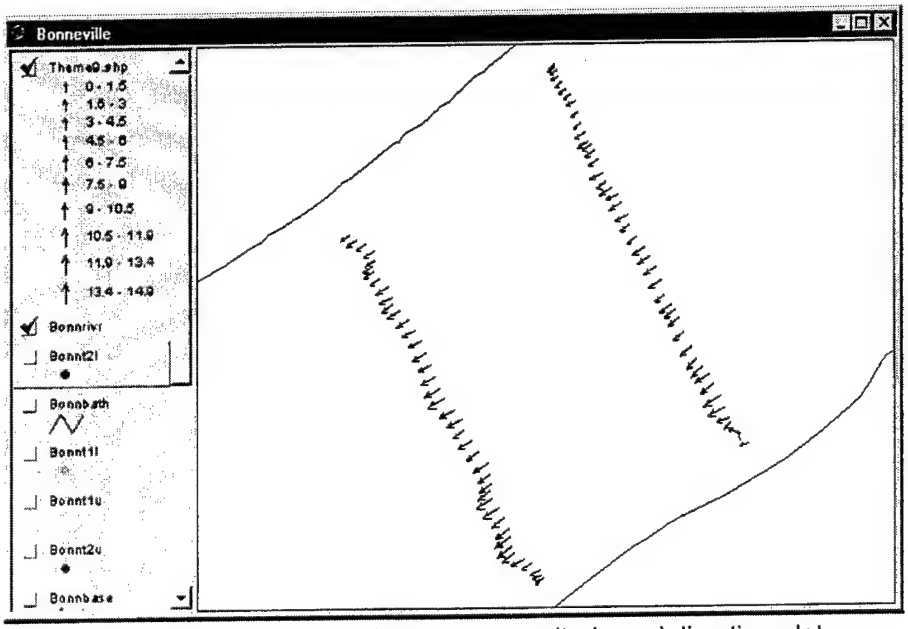

Figure 2-15. Example of a vector magnitude and direction plot

3 Cross-Section Analysis

The "Cross-Section Analysis" section of this report demonstrates the tools associated with generating cross-section plots from imported ADCP data. This tool allows the user to select data points from a plan view window to create the cross-section plot. The data can be selected along the transect line where they were collected or they can be selected at any angle to that line. Because the data is spatially tagged, cross sections can be generated from any set of points. This is a very powerful tool in that it allows the data to be viewed from any direction.

Generating Cross Sections

To generate a cross section from a transect, the desired data set should be active. Click on the *Generate Cross-Section* tool (Figure 3-1). The user is prompted to draw a polygon around the transect points (Figure 3-2). Define the polygon by clicking and double-click when the polygon is completed. Data points can be selected along the transect or across transects as shown in Figure 3-3.

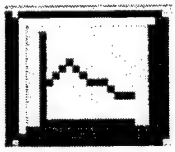

Figure 3-1. Generate cross-section tool

After HyPAS extracts the data, the user is asked to enter the starting point. This prompt is in the lower left corner. The user will know that HyPAS is ready for the starting point when the cursor returns to a cross hair. Click on the starting point for the cross sections. By defining the starting point, the user defines the orientation of the cross section, thereby, establishing a point of reference determining the direction of view. Therefore, the user can determine whether the user is looking into the channel or into the bay.

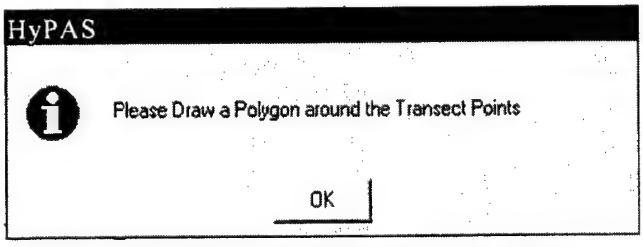

Figure 3-2. Instruction message box

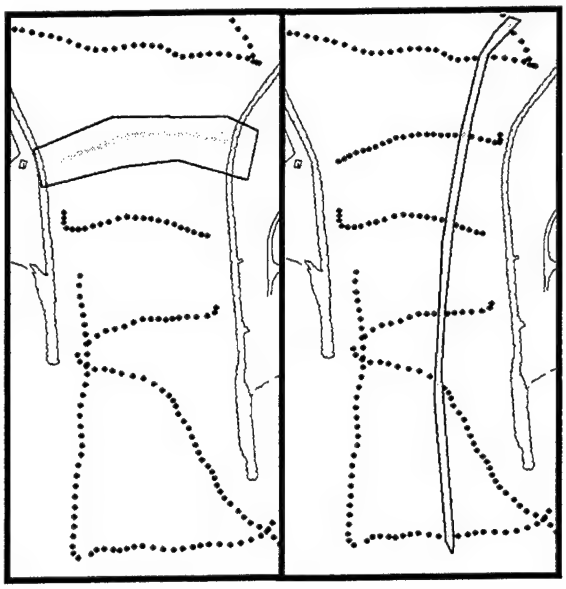

Figure 3-3. Examples of selecting transects for cross sections

HyPAS then prompts for the depth exaggeration (Figure 3-4). The default value is an estimate of the appropriate exaggeration based on the data. Because this number is based on the data, the actual extent of the cross-section axes may require less exaggeration. Enter the exaggeration and click *OK*.

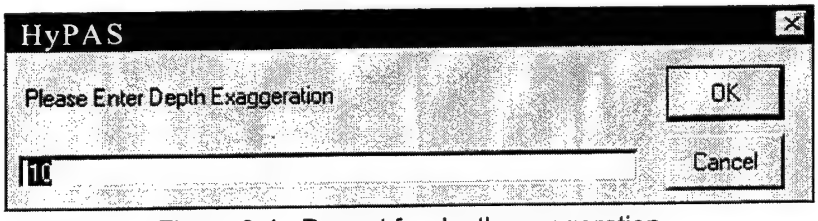

Figure 3-4. Prompt for depth exaggeration

HyPAS then prompts for the *Output Grid Specifications* (Figure 2-8). The output grid extent parameter defines the external limits of the resulting interpolation. Because HyPAS is setting the display to the extent of the data, the default response *Same as Display* is the best choice. The other three parameters—*Output Grid Cell Size, Number of Rows,* and *Number of Columns*—define the raster intensity of the output grid.

These parameters are connected; therefore, changing any one changes all. The user may want to adjust this. Increasing the number of cells smooths the output. The trade-off is that it decreases the speed of the interpolation process. The default value should be adequate for most applications, although rounding the cell size will increase clarity. HyPAS then prompts for the *Field to Interpolate* (Figure 3-5). Choose the desired constituent or field and click *OK*.

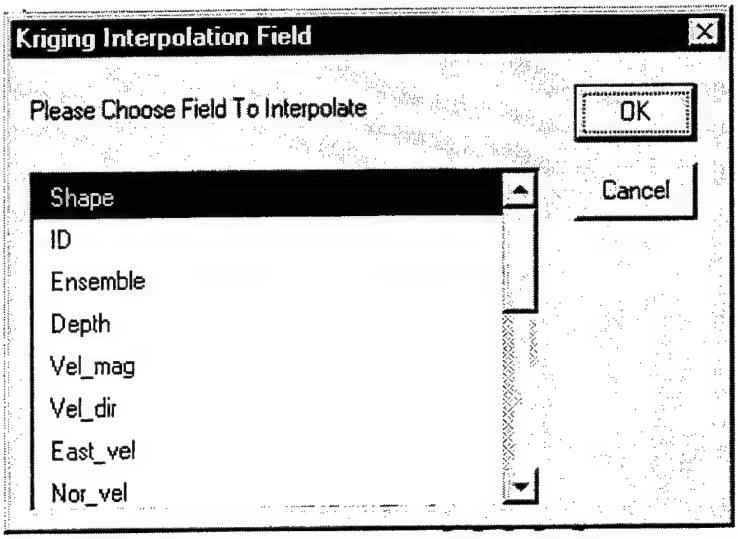

Figure 3-5. Menu to select field to interpolate

The user is then prompted for the *New Name for Output Grid* (Figure 3-6). This is the name for the resulting cross-section grid. Always enter a new name. HyPAS will not allow the user to overwrite another grid. After entering the output grid name, Click *OK*.

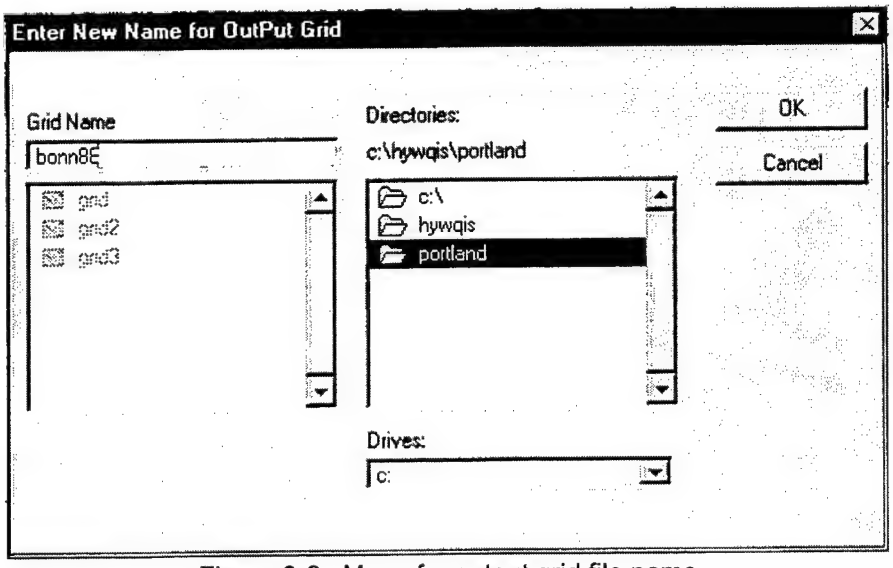

Figure 3-6. Menu for output grid file name

HyPAS then prompts with the *Cross-Section Plot Parameters* menu (Figure 3-7). This menu prompts for the *Depth Axis* (*Y*) limit, increment, and title and the *Distance Axis* (*X*) increment and title. These parameters affect the appearance of the resulting cross section. The *depth axis* limit is the maximum depth shown on the cross section. The increment is the amount between ticks on the axis. The title is the title to be placed on the axis. The *depth axis* limit must be equal or greater than the maximum depth of the data and evenly

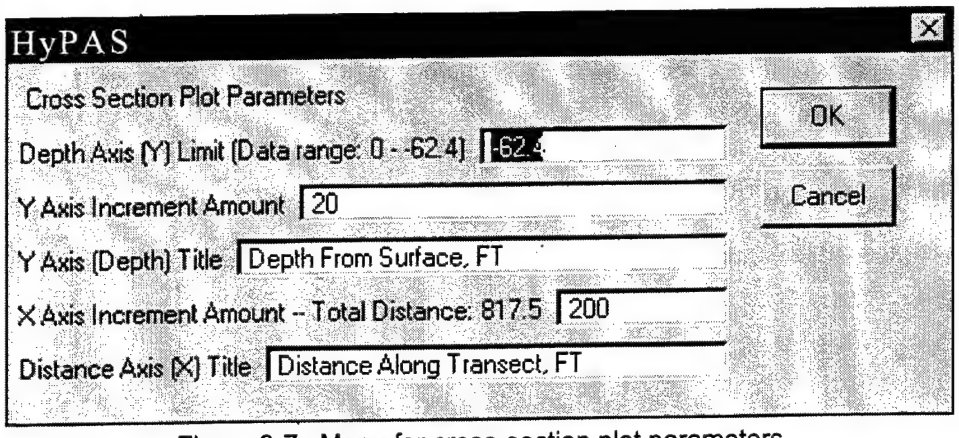

Figure 3-7. Menu for cross-section plot parameters

divisible by the axis increment. If the input does not satisfy these two conditions, the user will be prompted to re-enter those two parameters. The maximum depth of the data is the default value for the *depth axis limit.*

After the grid data set is completed, HyPAS prompts for the contour interval and base contour (Figure 2-11). Enter the desired contour interval and base contour.

HyPAS creates three themes in the *Cross Section* view: a point theme containing the cross-section points with each bin, a contour lines theme, and a theme with the interpolated data (Figure 3-8).

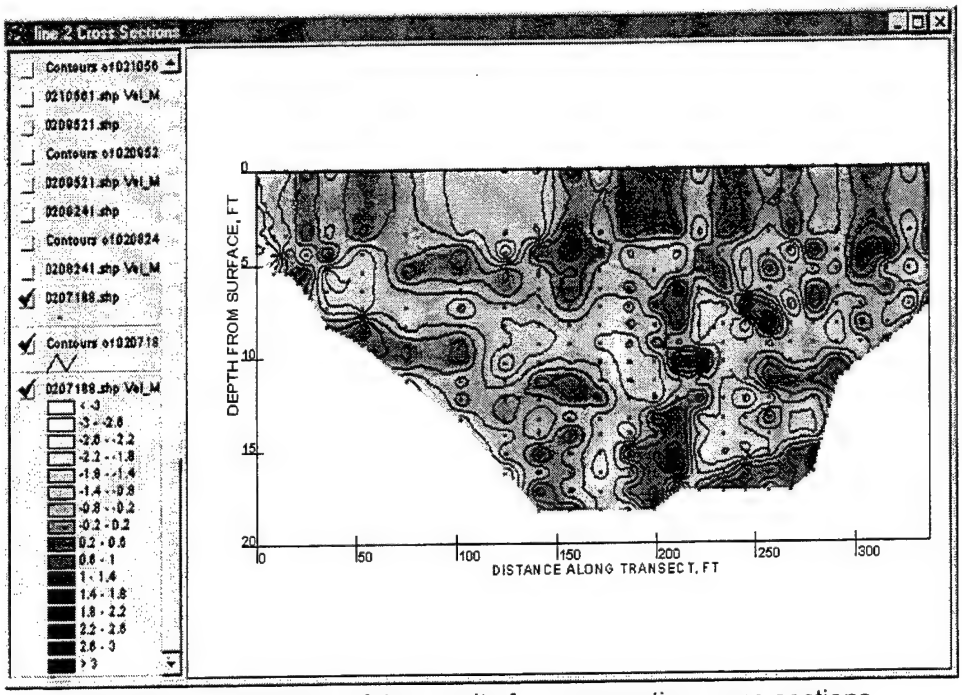

Figure 3-8. Example of the results from generating cross sections

4 Image Importing

The "Image Importing" section of this report demonstrates the tools associated with creating and populating an image theme. This tool was primarily designed to act as a method of storage of project information as related to spatial locations. It also has project management applications. In the reconnaissance phase of a project, images of gauge locations, aerial photographs, and site conditions are useful in planning. This tool allows these images to be stored in the database and later recalled for plotting, presentations, and analysis with the field data. Another application of this tool would be to incorporate images in the management of a construction or dredging project. As the project progresses, images can be stored and spatially tagged documenting all aspects of the construction. Construction drawings and other descriptive information can be stored on other themes.

Adding and Deleting Image Locations

To create an image location, assure that the photograph theme is active, and click on the *Add/Delete Image Tag Locations* tool (Figure 4-1). The user is prompted to add or delete an image location (Figure 4-2). Choose *Add Image Location* and click *OK*. Click the specific location on the map for importing images. After clicking the desired location, the user is prompted to enter a description for the location (Figure 4-3). After entering the description, the user is asked whether to import images now (Figure 4-4). Choose *Yes* to import image files and refer to the adding, deleting, and viewing image files section for details. Choose *No* to add more locations.

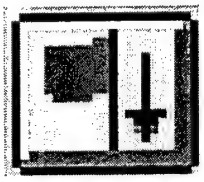

Figure 4-1. Add/delete image tag locations tool

If a photograph theme has not been created, no theme should be active. If no theme is active, HyPAS will prompt to select theme or create theme (Figure 4-5). To create a photograph theme, choose *Create Theme* and enter a theme name (Figure 4-6).

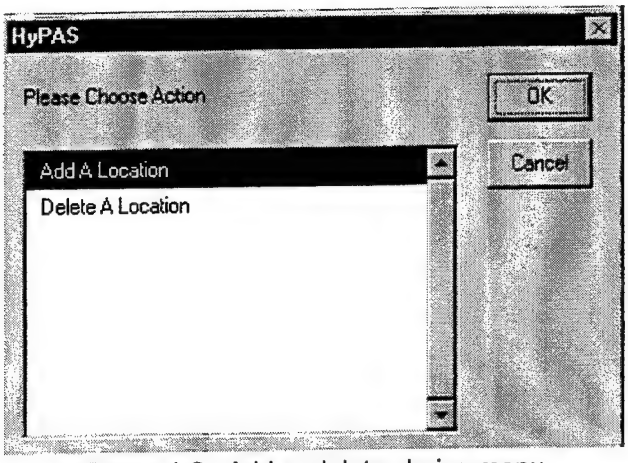

Figure 4-2. Add or delete choice menu

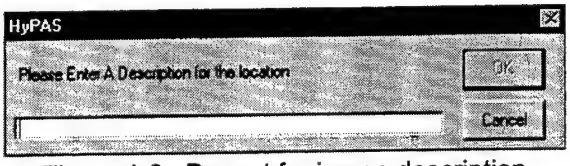

Figure 4-3. Prompt for image description

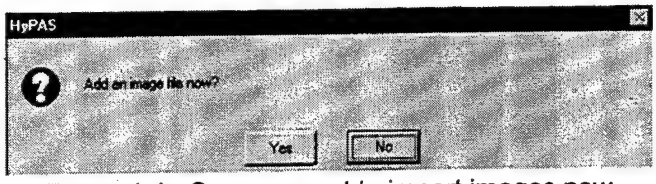

Figure 4-4. Query prompt to import images now

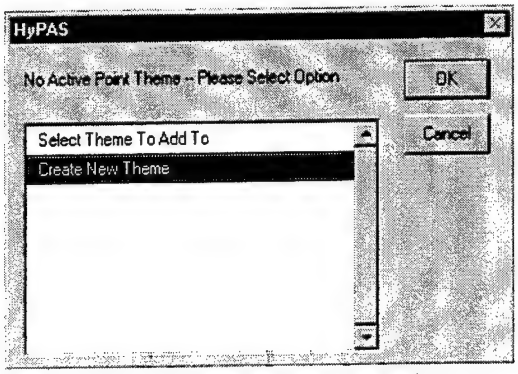

Figure 4-5. Select theme or create new theme choice menu

To delete an image location, assure the photograph theme is active. First, click on the *Add/Delete Image Tag Locations* tool (Figure 4-1) and choose the *Delete Image Locations* option (Figure 4-2). Then, click on the desired location to delete and confirm the deletion (Figure 4-7).

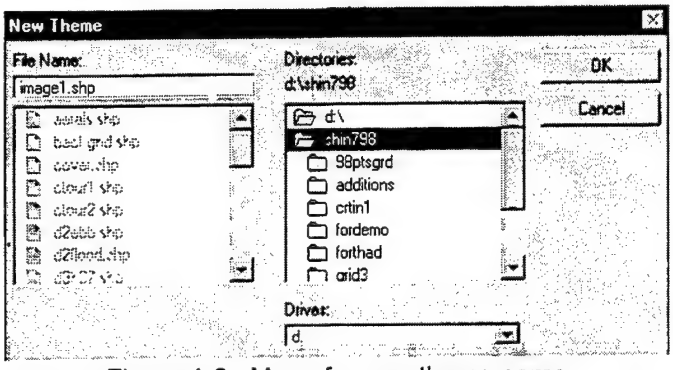

Figure 4-6. Menu for new theme name

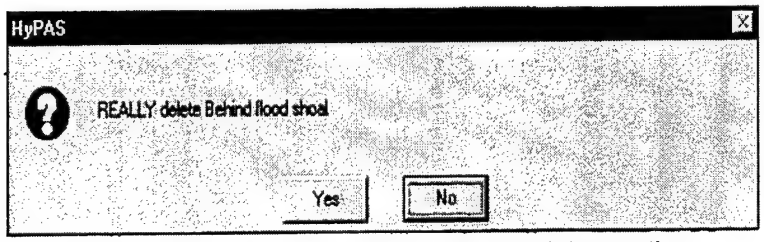

Figure 4-7. Query menu to confirm the delete action

Adding, Deleting, and Viewing Image Files

To add image files to a location, assure the photograph theme is active and click on the *Add/View/Delete Image Files* tool (Figure 4-8). Choose the *Add Image Files* option (Figure 4-9) and click the location to add the images. The user is prompted to select the image files to add (Figure 4-10). Any number of images up to 10 may be tied to a location.

Figure 4-8. Add/view/ delete image files tool

To delete image files from a location, assure the photograph theme is active and click on the *Add/View/Delete Image Files* tool (Figure 4-8). Choose the *Delete Image Files* option (Figure 4-9) and click the location to delete the images. The user is prompted to select the image files to delete (Figure 4-11).

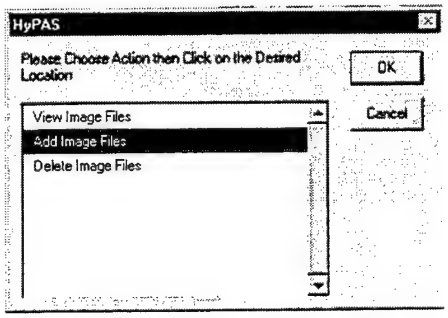

Figure 4-9. Action choice menu for image theme

To view images at a location, assure the photograph theme is active and click on the *Add/View/Delete Image Files* tool (Figure 4-8). Choose the *View Image Files* option (Figure 4-9) and click the location to view the images. The user is prompted to select the image files to view (Figure 4-12). The user may choose multiple images to view at once. The selected images are displayed in a separate window (Figure 4-13).

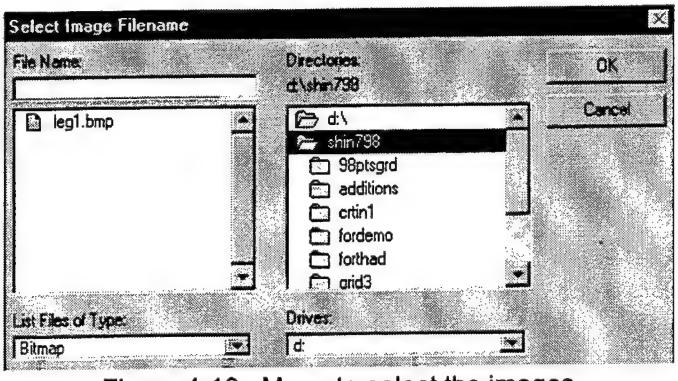

Figure 4-10. Menu to select the images

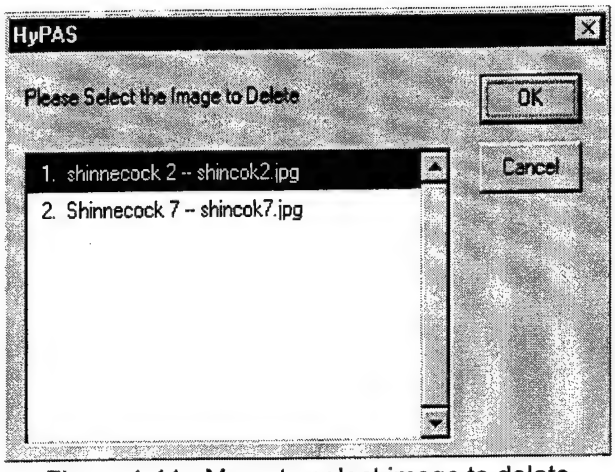

Figure 4-11. Menu to select image to delete

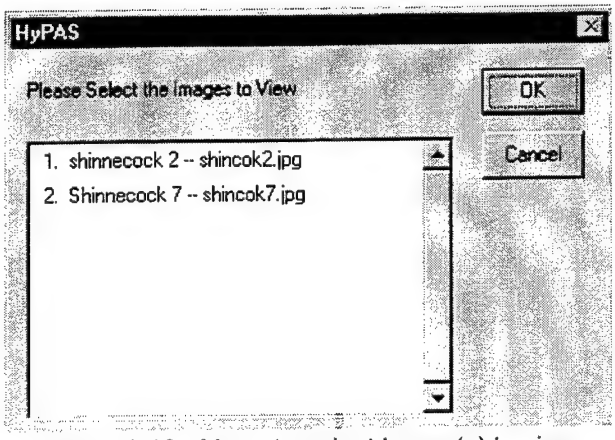

Figure 4-12. Menu to select image(s) to view

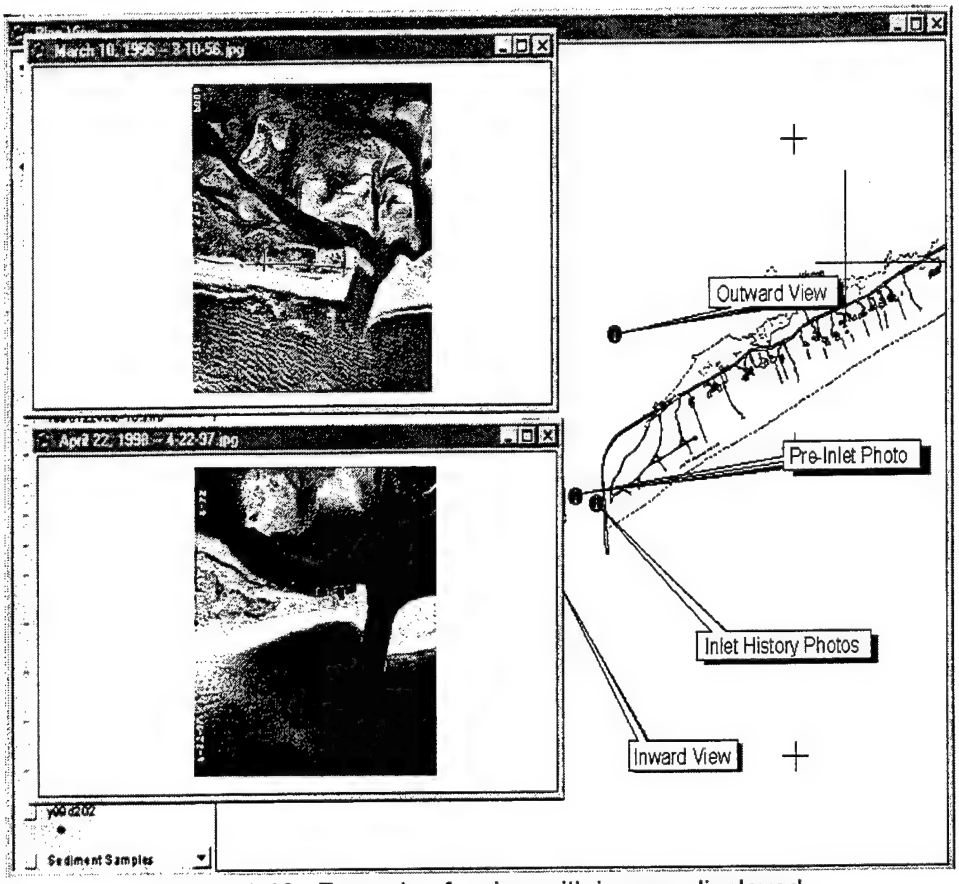

Figure 4-13. Example of a view with images displayed

5 Time Series Data Analysis

The "Time Series Data Analysis" section of this report demonstrates how to populate, analyze, and plot time series data inside a GIS system. GIS databases do not typically have the functionality of time series analysis. This tool enables file storage at the gauge location within the project area. The capability to subsection and merge files for longer time series plots or exporting ASCII files is useful for creating boundary condition files for numerical models or other applications. This functionality was added to the HyPAS extension because not all hydrodynamic data collected are static in time and space.

Adding and Deleting Time Series Data Locations

To create a time series data location, assure that the time series data theme is active, and click on the *Add/Delete Time Series Data Locations* tool (Figure 5-1). The user is prompted to add or delete a location (Figure 4-2). Choose *Add a Location* and click *OK*. Click the specific location on the map for the time series data identifier location. After clicking the desired location, the user is prompted to enter a description for the location (Figure 4-3). The location is now ready to include time series data for analysis.

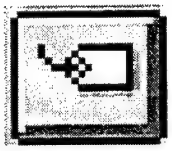

Figure 5-1. Add/delete time series data locations tool

If a time series data theme has not been created, no theme should be active. If no theme is active, HyPAS will prompt to select theme or create theme (Figure 4-5). To create a time series data theme, choose *Create Theme* and enter a theme name (Figure 4-6).

To delete a time series data location, assure the time series data theme is active. First, click on the *Add/Delete Time Series Data Locations* tool (Figure 5-1) and choose the *Delete a Location* option (Figure 4-2). Then, click on the desired location to delete and confirm the deletion (Figure 4-7).

Adding, Deleting, and Analyzing Time Series Data

To add, delete, or analyze time series data, assure the time series data theme is active and click on the *Add/View/Analyze Time Series Data* tool (Figure 5-2) and click on the desired time series data location. HyPAS displays the *Time Series Data Analysis* menu (Figure 5-3).

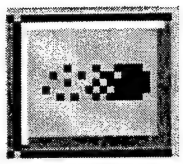

Figure 5-2. Add/delete/analyze time series data tool

To add time series data to a location, click on the *Add Data* option. A menu showing all time series data types is displayed (Figure 5-4). Click on the type of data to add. A report menu is shown describing the file format for the import file. These data must be in a comma-delimited text (.txt) file. The first five fields must be *Year, Month, Day, Hour, and Minute.* The remainder of the data must contain at least one field of a *Quantity Value* for *Display.* This file must have six header lines and one line of column titles. A data file format example is shown below:

Header Info
Header Info
Header Info
Header Info
Header Info
Header Info
Year, Month, Day, Hour, Minute, temp-avg-c, temp-max-c, temp-min-c
1998,5,18,12,30,9.2,9.4,8.9
1998,5,18,12,45,9.1,9.3,8.9

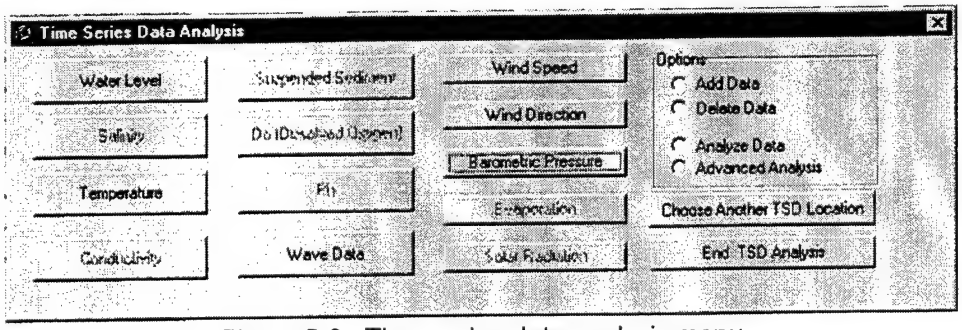

Figure 5-3. Time series data analysis menu

The user is then prompted to select the file containing the data (Figure 5-5). The data are read, and the user is prompted to select the columns of data to import (Figure 5-6) because one file may contain extra columns of data. The user will be returned to the file selection menu (Figure 5-5) to select more files. Click *Cancel* when finished importing data files for this type. The data are imported and ready for analysis.

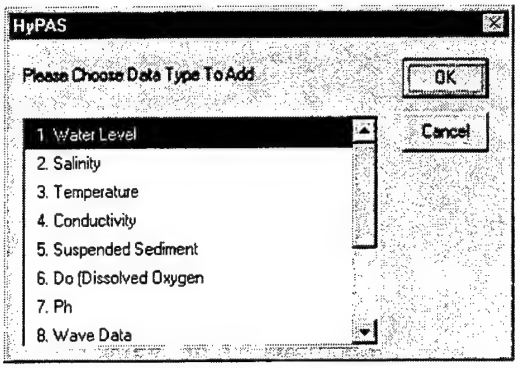

Figure 5-4. Data type selection menu

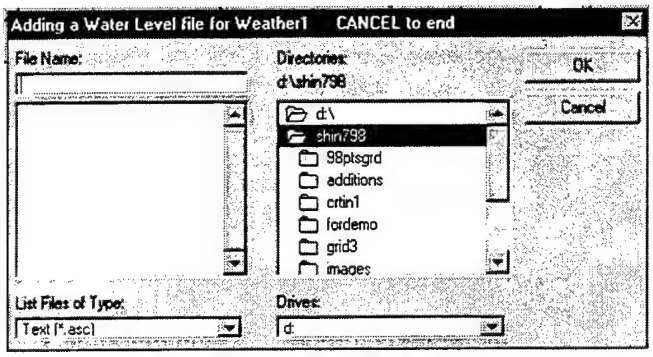

Figure 5-5. File selection menu

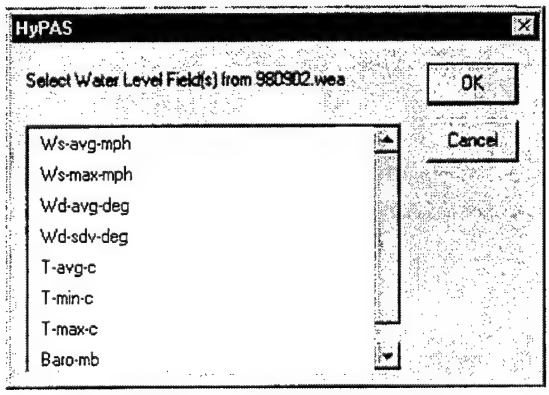

Figure 5-6. Field selection menu

To delete time series data from a location, click on the *Delete Data* option from the *Time Series Data Analysis* menu (Figure 5-3). A menu showing the time series data types with data is displayed (Figure 5-7). Click on the type of data to delete. The user is shown all imported files of the selected data type for the location and asked to select the file to delete (Figure 5-8). Choose the file and click *OK* to delete the data.

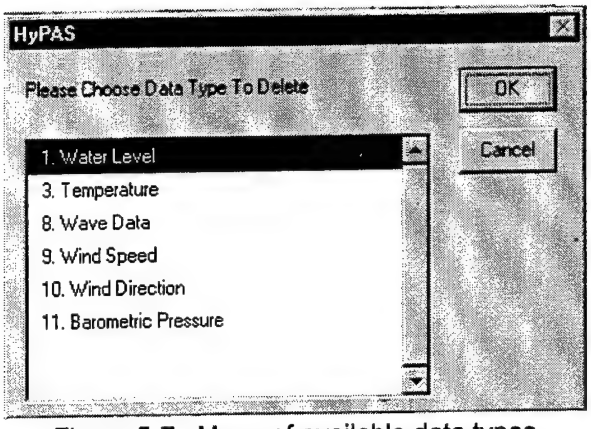

Figure 5-7. Menu of available data types

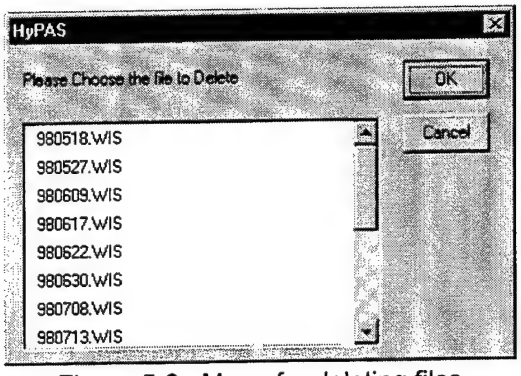

Figure 5-8. Menu for deleting files

To analyze time series data at a location, click on the *Analyze Data* option. A menu showing all available time series data types is displayed (Figure 5-9). Click on the type of data to analyze. The user is shown all imported files for the selected data type and asked to select the file(s) to analyze (Figure 5-10). Select the file(s) and click *OK*. The user is then shown the columns of data in the selected file(s) (Figure 5-11). Choose the column to plot.

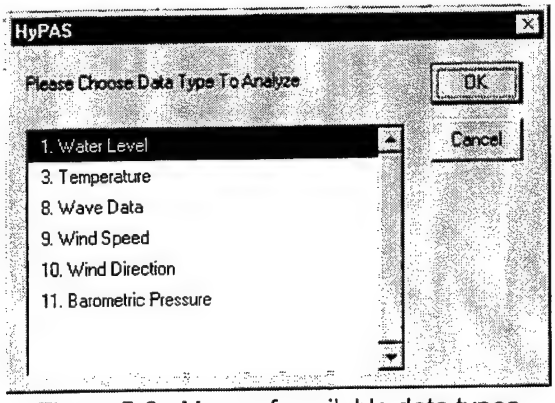

Figure 5-9. Menu of available data types

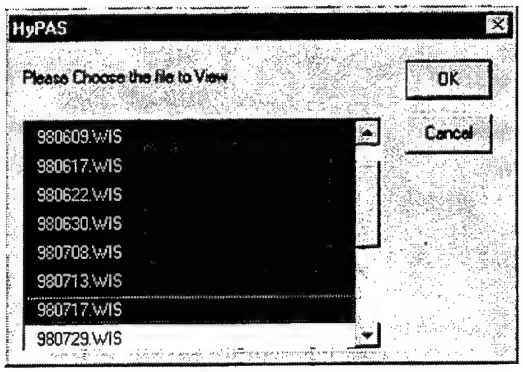

Figure 5-10. Menu for analyzing files

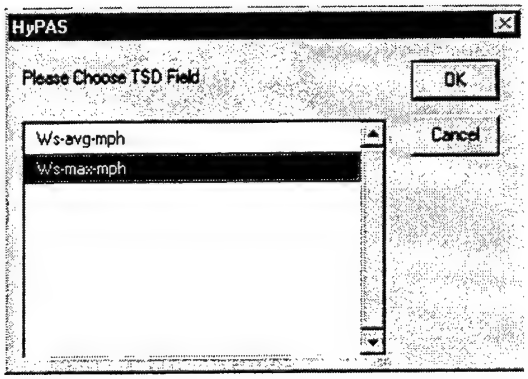

Figure 5-11. Menu of available fields from the selected data files

The header information is displayed for the imported file. If multiple files were selected, the header information for the first file is displayed. A menu prompting for plotting parameters is displayed (Figure 5-12).

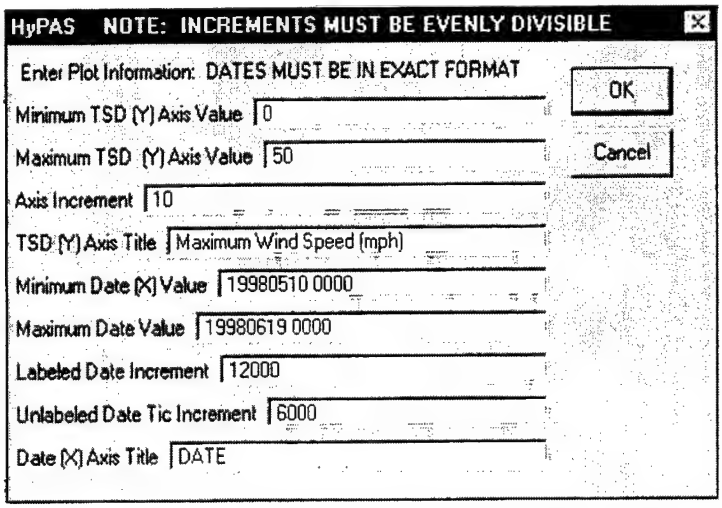

Figure 5-12. Time series data plot parameters menu

Each option is described as follows:

Minimum TSD (Y) Axis Value. This is the y-axis minimum value. Enter a value less than or equal to the default value. The default value is the minimum value of the data.

Maximum TSD (Y) Axis Value. This is the y-axis maximum value. Enter a value greater than or equal to the default value. The default value is the maximum value of the data.

Axis Increment. This is the y-axis labeled tic marks. This number must be evenly divisible into the difference of the maximum and minimum values.

TSD (Y) Axis Title. This is the y-axis title. This title will be parallel with the y-axis and approximately centered vertically to the left of the y-axis.

Minimum Date (X) Value. This is the x-axis minimum value. It is a date and must be in the format of four digits for the year, two digits for the month, two digits for the day, a space and four digits for the time (e.g., yyyymmdd hhmm). The time must be in military time. An example would be. 19980730 1300.

Maximum Date (X) Value. This is the x-axis maximum value. It is a date and must also follow the format listed above.

Labeled Date Increment. This is the x-axis labeled tic marks. This number must be evenly divisible into the difference of the maximum and minimum dates. It must be in the four-digit military time.

Unlabeled Date Tic Increment. This is for unlabeled x-axis tic marks. This allows additional tics to be placed in the x-axis without placing text with the tics. This number must be the same criteria as the labeled date increment.

Date (X) Axis Title. This is the x-axis title. This title will be parallel with the x-axis and approximately centered below the x-axis.

After entering the desired parameters, click *OK*. If the minimum, maximum, and increment values do not meet the specified criteria, a second menu for these parameters will be displayed for the user to re-enter. These data are organized and plotted in the *Time Series Data* view, but are not displayed. A menu is displayed asking *Plot Data Now*? To analyze another time series data file, choose *No* and start over. To see the results, choose *Yes*. The data plotted in the *Time Series Data* view are displayed (Figures 5-13 and 5-14), and the user is prompted whether to export the data. Choose *Yes* and enter a file name to export the data.

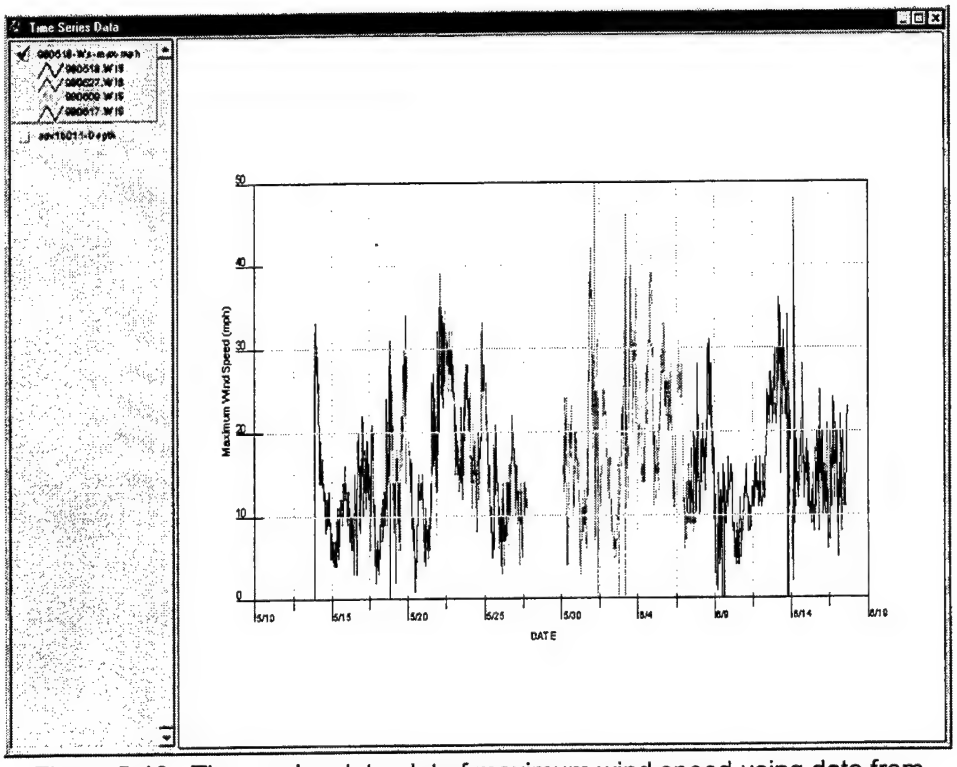

Figure 5-13. Time series data plot of maximum wind speed using data from four files spanning approximately 5 weeks of data

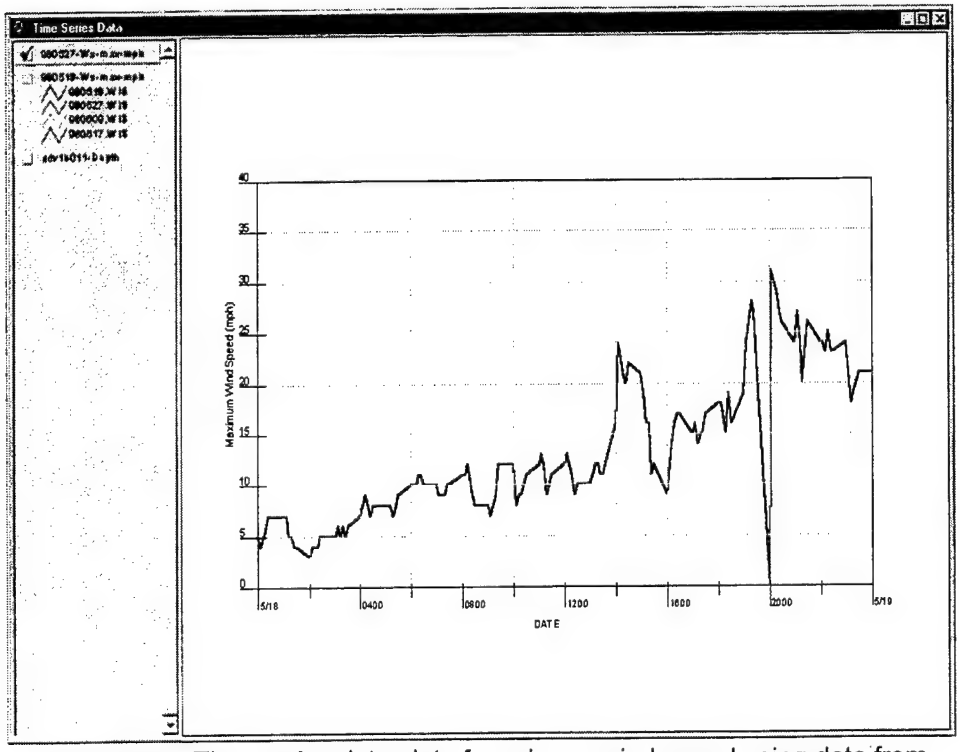

Figure 5-14. Time series data plot of maximum wind speed using data from one file spanning one day of data

6 Soil Sample Analysis

The "Soil Sample Analysis" section of this report demonstrates how to populate a soil (sediment) sample theme. Once the theme is populated, sample points can be chosen for further analysis. There are many different types of analyses within the soil sample toolbox. Size distribution plots for single or multiple samples can be extracted. As with the other spatial tools, different types of data can be displayed concurrently, giving the user further insight into the current problem. For example, bathymetry or velocity data can be displayed in the background while selecting sample locations, giving the user the ability to make a selection based on physical parameters rather than conjecture.

Importing

To import soil sample data, click on the *Import Data* for HyPAS button (Figure 2-1) and choose the *Import Soil Sample File* option (See Figure 2-2). Next, select the soil sample file in the *Select Soil Sample File* menu which appears (Figure 6-1). HyPAS imports the data, creates a soil samples' theme for analysis, creates a composite table with a composite sample of all samples, and creates a composite analysis table for calculating the adjusted fill factor (R_A) and the renourishment factor (R_J). The data file to import must be in the following format. Please note that the first six lines contain header information to be applied to the theme. The next line is column headers. The first six columns' headers must be exactly as shown. The rest of the column headers are the sieve sizes used in the sample. One record (line) should follow for every sample.

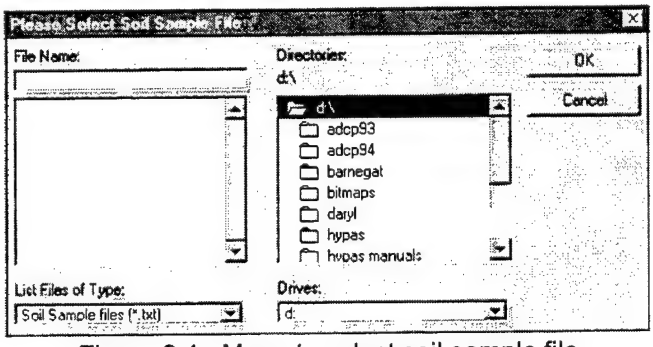

Figure 6-1. Menu to select soil sample file

Header Line 1
Header Line 2
Header Line 3
Header Line 4
Header Line 5
Header Line 6
id,station,x,y,MinDepth,MaxDepth,date,Sampletype,totalwgt,numsieves,-6.25,-6.0,-5.0,-4.0,-3.0,-2.25,-2.00,-1.75,-1.5,-1.25,-1.00,-0.75,-0.50,-0.25,0.00,0.25,0.5,0.75,1.00,1.25,1.50,1.75,2.00,2.25,2.5,2.75,3.00,3.25,3.50,3.75,4.00,4.25
SHI001,CHA1
,1406034.39,248392.072,0.0,0.2,19980720,GRAB,23.909,27,999.,999.,999.,999.,999.,.000,.116,.001,.063,.004,.006,.008,.075,.158,.337,1.123,1.630,3.187,6.387,6.970,
2.053,1.187,.431,.128,.041,.014,.002,.000,.000,.002,.000,.000
SHI002,CHA2
,1405546.26,248390.668,0.0,0.2,19980720,GRAB,20.818,27,999.,999.,999.,999.,999.,.000,.002,.000,.000,.001,.010,.017,.040,.037,.079,.222,.285,.684,2.270,6.084,
4.821,4.304,1.495,.343,.091,.035,.014,.013,.018,.013,.000,.000

Plotting Frequency Weight Histogram

To plot the frequency weight histogram, have the soil sample theme active and the specific desired samples selected. Click on the *Grain Size Frequency Analysis* button (Figure 6-2). An option choice menu will be displayed; choose *Plot Frequency Weight Histogram* (Figure 6-3). In addition to the plan view currently displayed, a *Soil Sample Percent Histogram* view with the soil samples plotted and a table will be opened. All three of the displays will be interconnected such that any selection in one window will be reflected in the other two. There is not a limit to the number of desired samples plotted at one time.

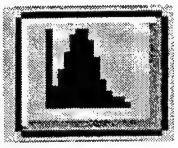

Figure 6-2. Grain size frequency analysis button

Plotting Cumulative Frequency Weight Percent

To plot cumulative frequency weight percent, have the soil sample theme active and the specific desired samples selected. Click on the *Grain Size Frequency Analysis* button (Figure 6-2). An option choice menu will be displayed; choose *Plot Cumulative Frequency Weight Percent* (Figure 6-3). The user is prompted to select the type of y-axis (Figure 6-4). Choose the desired y-axis and click *OK*. In addition to the plan view currently displayed, a *Cumulative Probability Soil Sample Percent Plots* view with the soil samples plotted and a table will be opened.

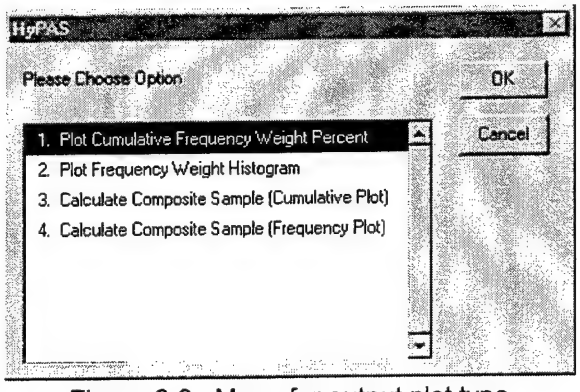

Figure 6-3. Menu for output plot type

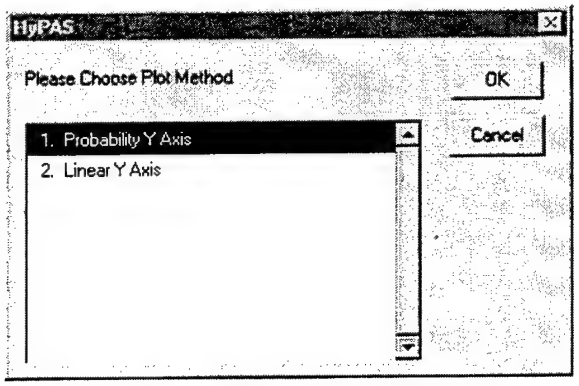

Figure 6-4. Menu to select axis type

All three of the displays will be interconnected such that any selection in one window will be reflected in the other two. There is not a limit to the number of desired samples plotted at one time.

Additional Notes for Plotting

Once the user has plotted another set of samples, the interconnection to the last set is deleted. To relink a previous set of soil sample plots, open the soil sample view and activate the specific theme for the plotted samples. Then, click on the *Relink Soil Sample Data* button (Figure 6-5). The active theme is now the interconnected soil sample plots theme. See Figure 6-6 for an example plot.

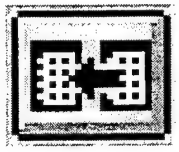

Figure 6-5. Relink soil sample data button

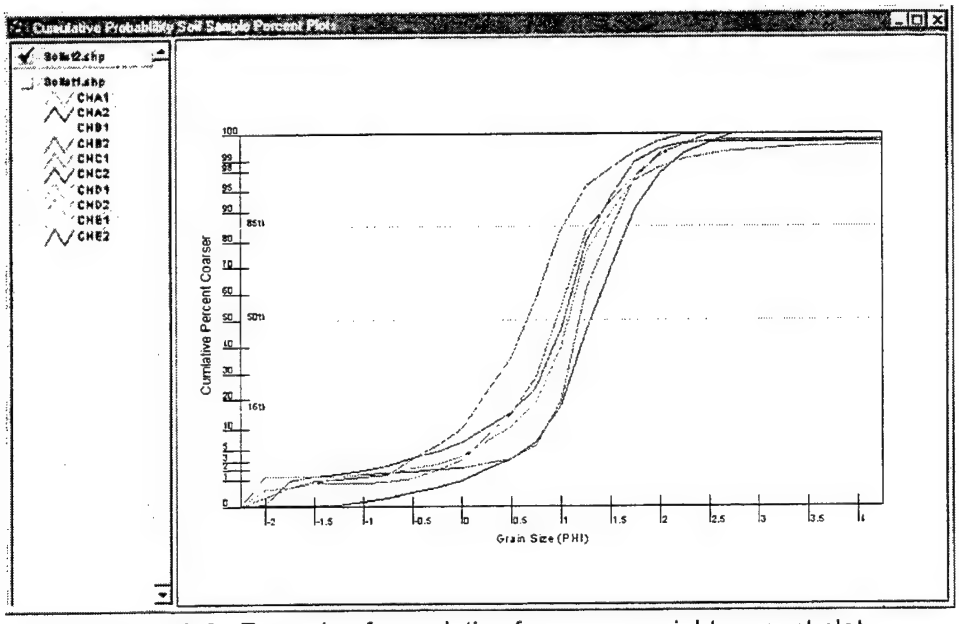

Figure 6-6. Example of cumulative frequency weight percent plot

Calculating Composite Samples

To calculate a composite sample, have the soil sample theme active and the specific desired samples selected. Click on the *Grain Size Frequency Analysis* button (Figure 6-2). An option choice menu will be displayed; choose either *Calculate Composite Sample (Cumulative Plot)* or *Calculate Composite Sample (Frequency Plot)* (Figure 6-3). A composite sample will be created in the composite table and the composite sample will be plotted. If the cumulative plot choice was selected, then a cumulative frequency weight percent plot will be generated. If the frequency plot choice was selected, then a frequency weight histogram plot will be generated. The plot routines will follow the procedures described in the previous sections.

Comparing Composites with Reference Curve

To calculate the adjust fill factor (R_A) and the renourishment factor (R_J), open the composite analysis table. Then, click on the *Perform Composite Analysis* tool (Figure 6-7). The user is prompted to select the composite sample (record) in the table to calculate the R_A and R_J. Click on the desired record. The user is prompted for the reference PHI 16 and PHI 84. Enter the reference PHIs. If the user knows the reference mean and sorting in PHI, then press cancel, and be prompted for the mean-PHI and the sorting-PHI. The R_A and R_J are calculated and applied to the respective fields. See Figure 6-8 for an example of the table. See CETN-II-15 (1986)[1] for a discussion of the factors.

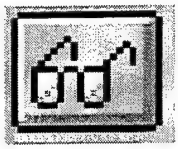

Figure 6-7. Perform composite analysis tool

id	CompositeID	TotalSamples	TotalWgt	Median-PHI	Mediumsan	Mean-PHI	Mean-mm	Sorting	PHI16	PHI84	RA	RJ
SHI-C001	All Samples	119	37.017	1.174	0.64	1.057	0.69	0.719	0.339	1.776	1.000	1.000
SHI-C002	Inlet Samples	10	44.073	0.688	0.66	0.363	1.02	0.826	-0.463	1.189	1.000	0.324
SHI-C003	South Shoreline	12	39.212	1.277	0.59	1.117	0.68	0.799	0.318	1.917	1.096	0.965
SHI-C004	North Shoreline	13	63.150	0.111	1.11	-0.085	1.37	0.841	-0.925	0.756	1.000	0.170
SHI-C005	Flood Shoal	20	28.422	1.435	0.56	1.391	0.47	0.763	0.628	2.153	1.700	1.494

Figure 6-8. Composite sample table with R_A and R_J factors

[1] Hands, E.B. and Chu, Y. (1986). *"Overfill and renourishment factors,"* Coastal Engineering Technical Note CETN-II-15, U.S. Army Research and Development Center, Coastal and Hydraulics Laboratory, Vicksburg, MS, http://chl.wes.army.mil/library/publications/cetn/

7 Plotting

This section describes the methodology for creating hard copy outputs from HyPAS. HyPAS uses ArcView's printing options for plotting.

To plot a view, go to the *File* menu and pull down to the *Print* option. This can be done from the view desired to plot. The user may need to set the appropriate printer parameters. Choose *Setup* from the print menu. ArcView will use the Windows printer driver or create a file itself if the printer allows it (Figure 7-1).

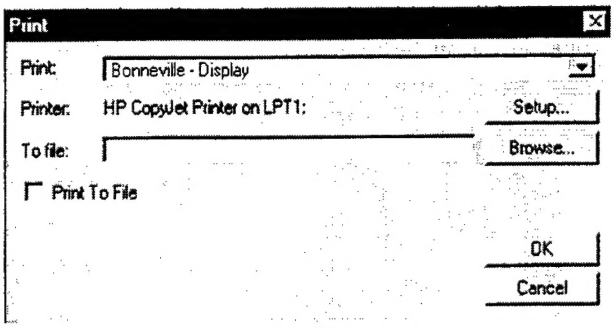

Figure 7-1. ArcView print menu

To create a custom map, go to the *View* menu item and choose *Layout.* ArcView automatically creates a layout with the view name, map area, legend, north arrow, and scale bar. The user can then plot the layout from the file menu as previously described for plotting a view. ArcView provides many advanced features using layouts. For description of these capabilities, see chapter 10 of *Using ArcView GIS* or the ArcView online help.[1]

After creating a layout, the user can export to an image file in lieu of a hard copy output. From the layout, click the *File Menu* option, and choose *Export.*

[1] Environmental Systems Research Institute, Inc. (1996). "Using ArcView GIS," Redlands, CA.

ArcView can export to the following image files:

a. Windows Meta File (WMF).

b. Placeable WMF.

c. Windows Bitmap (BMP).

d. Postscript (EPS).

e. Adobe Illustrator.

f. JPEG/JFIF image.

The user can also select the objects in the layout, copy them to the clipboard, and paste them into a document in another application.

8 Future Enhancements

Future Enhancements are ideas presented by users and clients. If sufficient comments are received requesting changes and additions, then modifications and enhancements will be made. HyPAS was initially developed and supported through the years from client requests and funding. The CIRP has funded several of the tools at the request of users.

The following functionality is under consideration for implementation:

a. Perform arithmetic calculations on resultant data.

b. Convert acoustic backscatter data from an ADCP to sediment concentration data for further analysis.

c. Importing and exporting capabilities.

d. Statistical analysis tools.

e. Math functions to allow comparison of multiple data types such as bathymetry, shoreline position, material properties, and any type of scalar quantity.

f. Import physical model data and implement into current plan view analysis.

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14. ABSTRACT

Modern electronic instrumentation produces large amounts of data. Often, this abundance of data is not fully utilized because the engineer or scientist does not have an effective way to visualize and analyze it within project time schedule. This problem can be minimized by a set of tools that provides ready capability to visualize, analyze, reduce, and efficiently plot data obtained from such instrumentation. Additionally, such a tool can take advantage of geographically referenced data of high spatial accuracy.

HyPAS is designed to be a Geographic Information System (GIS) for hydraulic information. GIS, a computer system capable of managing, storing, manipulating, and displaying geographically referenced data, is the logical solution to such a problem, in particular considering the combination of spatial accuracy needs and database management needs. A mapping system alone lacks database management capabilities. A spreadsheet or database management system contains little or no accurate mapping capabilities. GIS software provides both applications with a robust set of tools capable of manipulating large amounts of data with high spatial accuracy; however, typically a substantial learning investment is required to become proficient with GIS software.

15. SUBJECT TERMS

ADCP, Acoustic Doppler Current Profiler, Data	GIS, Geographical Information System	Suspended Sediment Data
Bathymetry Data	Grain Size Analysis	Time Series Data
Bed Material Samples	Shoals Surveys	

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